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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/682,637	10/08/2003	Brian A. Hargreaves	STFUP091/S03-034	1250

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EXAMINER	
VARGAS, DIXOMARA	
ART UNIT	**PAPER NUMBER**
2859	

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	04/09/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary	Application No.	Applicant(s)
	10/682,637	HARGREAVES ET AL.
	Examiner	Art Unit
	Dixomara Vargas	2859

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.
2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.
3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-27* is/are pending in the application.
  4a) Of the above claim(s) _____ is/are withdrawn from consideration.
5)☐ Claim(s) _____ is/are allowed.
6)☒ Claim(s) *1-27* is/are rejected.
7)☐ Claim(s) _____ is/are objected to.
8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.
10)☒ The drawing(s) filed on *24 June 2004* is/are: a)☒ accepted or b)☐ objected to by the Examiner.
  Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
  Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
  a)☐ All b)☐ Some * c)☐ None of:
    1.☐ Certified copies of the priority documents have been received.
    2.☐ Certified copies of the priority documents have been received in Application No. _____.
    3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
  * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08)
  Paper No(s)/Mail Date *05/17/04*.
4) ☐ Interview Summary (PTO-413)
  Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Information Disclosure Statement

1. The listing of references in the specification is not a proper information disclosure statement. 37 CFR 1.98(b) requires a list of all patents, publications, or other information submitted for consideration by the Office, and MPEP § 609.04(a) states, "the list may not be incorporated into the specification but must be submitted in a separate paper." Therefore, unless the references have been cited by the examiner on form PTO-892, they have not been considered, for example, the non patent literature "Optimized Waveforms for Spiral Scanning" Magnetic Resonance Med. 1995; 34:156-160 as discussed in page 4 paragraph 0027 of the specification.

Claim Rejections - 35 USC § 112

2. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

3. Claims 10-13 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

   a. With respect to claims 10-13, the mathematical expressions in the claim are indefinite since the claim language fails to show what the terms stand for and one of ordinary skill in the art would have not been able to understand what is the definition of the terms in the expression. The undefined terms are n, H_x, α, β, S_x, C_x, d.

Claim Rejections - 35 USC § 101

4. 35 U.S.C. 101 reads as follows:

> Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

5. Claims 1-27 are rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter.

The claimed invention is directed to a judicial exception to 35 U.S.C. 101 (i.e., an abstract idea) and is not directed to a practical application of such judicial exception (e.g., because the claim does not require any physical transformation and the invention as claimed does not produce a useful, concrete, and tangible result). The language in the claim suggest only a combination of instructions without reciting a structure associated to the procedure and lacks a tangible result and the end of the procedure.

Claim Rejections - 35 USC § 102

6. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.
>
> (f) he did not himself invent the subject matter sought to be patented.

7. Claims 1-27 are rejected under 35 U.S.C. 102(f) because the applicant did not invent the claimed subject matter. The non-patent literature "Time-optimal Multidimensional Gradient Waveform Design for Rapid Imaging" discloses the claimed invention. However, said non-

patent literature has an additional inventor, Dwight G. Nishimura, not cited in the current application.

8. Claims 1, 2, 4-8, 13-24 are rejected under 35 U.S.C. 102(b) as being anticipated by Meyer et al. (US 6,020,739 A).

With respect to claim 1, Meyer discloses a method of magnetic gradient waveform design for rapid magnetic resonance imaging using constrained optimization comprising the steps of: selecting a number N of discrete-time waveforms with a sampling period, τ, and time $T=N\tau$ (Column 4, lines 11-40), expressing constraints as equations (Columns 4, 5 and 6, lines 48-65, 61-67 and 1-35 respectively), identifying if a solution exists for T, and if not, increasing T until a solution exists, decreasing T to find a shortest solution (Columns 3-4, lines 54-67 and 1-40 respectively), and solving the equations to identify the solution (Column 5, lines 30-60).

9. With respect to claim 2, Meyer discloses the step of utilizing linear programming to identify the solution (Columns 5-6, lines 48-67 and 1-19 respectively)

10. With respect to claim 4, Meyer discloses the step of utilizing L1-norm formulation (Column 4, lines 40-67 wherein the gradient vector is calculated as a absolute value or norm).

11. With respect to claims 5-7, 14-16 and 18-20, Meyer discloses the step wherein the gradient is one of one dimensional, two-dimensional or three-dimensional (Column 6, lines 60-65).

12. With respect to claims 8, 17 and 21, Meyer discloses the step wherein the gradient amplifier has current and voltage limits (I_{max} and V_{max}) that result in the following limits on

$G(p)$: $|G(t)| \leq \eta I_{max}$ and $\left|L\frac{d}{dt}G(t)+RG(t)\right| \leq \eta V_{max}$ where L, R and η are the gradient coil inductance, resistance, and efficiency (Columns 4 and 6 , lines 11-25 and 20-65 respectively).

13. With respect to claim 13, Meyer discloses the step of using a binary search to minimize time in identifying the minimum value of n which provides a solution (Columns 3-4, lines 64-67 and 1-36 respectively).

14. With respect to claim 22, Meyer discloses the step of establishing physical constraints of a gradient amplifier and a gradient coil (Columns 3-4, lines 64-67 and 1-36 respectively).

15. With respect to claims 23 and 24, Meyer discloses the step of establishing beginning and end gradient boundary constraints and a fixed area for one or more gradient moments (Columns 3-4, lines 64-67 and 1-36 respectively).

Claim Rejections - 35 USC § 103

16. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

17. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later

invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

18. Claims 25-27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Meyer et al. (US 6,020,739 A) in view of Orlando Simonetti et al. ("An Optimal Design Method for Magnetic Resonance Imaging Gradient Waveforms").

With respect to claims 25-27, Meyer discloses the claimed invention as stated above in paragraph 7 except for the step of including gradient heating and magneto stimulation constraints. However, Simonetti discloses the step of including gradient heating and magneto stimulation constraints (pages 351-352, section B. Objectives, part I and II). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to include gradient heating and magneto stimulation constraints as taught by Simonetti with Meyer's method of magnetic gradient waveform design for rapid MR imaging using constrained optimization for the purpose of preventing excessive overheating, energy dissipation and reducing the eddy currents and other errors that degrades the image as taught by Simonetti (pages 351-352, section B. Objectives, part I and II).

Allowable Subject Matter

19. Claims 3, 9-12, are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

20. Claims 10-12 would be allowable if rewritten to overcome the rejection(s) under 35 U.S.C. 112, 2nd paragraph, set forth in this Office action and to include all of the limitations of the base claim and any intervening claims.

21. The following is a statement of reasons for the indication of allowable subject matter:

b. With respect to claim 3, the claim has been found allowable over the prior art of record because the prior art of record fails to teach or fairly suggest a method of magnetic gradient waveform design for rapid MR imaging using constrained optimization comprising the step wherein the linear programming finds the vector x that minimizes a cost function $f^T x$ subject to the constraint $Ax \leq b$, wherein matrix A and vector b are formed by combining all of the linear constraint equations for the amplifier and pulse sequence constraints in combination with the remaining limitations of claims 1 and 2 above.

c. With respect to claim 9, the claim has been found allowable over the prior art of record because the prior art of record fails to teach or fairly suggest a method of magnetic gradient waveform design for rapid MR imaging using constrained optimization comprising the step of adding slack variables (as defined in the specification, paragraphs 0046-0050) to the optimization in combination with the remaining limitations of claim 1 above.

d. With respect to claims 10 and 11, the claims have been found allowable due to its dependency on claim 9 above.

e. With respect to claim 12, the claim has been found allowable over the prior art of record because the prior art of record fails to teach or fairly suggest a method of magnetic gradient waveform design for rapid MR imaging using constrained optimization comprising the step of utilizing a second order cone programming (SOCP) to find a solution x that minimizes a linear pulse function $f^T x$ subject to a second order cone constraint $\|Ax + b\|_2 \le Cx + d$ which is superset of the linear constraints in linear programming where matrix A and vector b are formed by combining all linear constraint equations for amplifier and pulse sequence constraints in combination with the remaining limitations of claim 1 above.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Dixomara Vargas whose telephone number is (571) 272-2252. The examiner can normally be reached on Monday to Thursday from 8:00 am. to 4:30 pm..

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Diego Gutierrez can be reached on (571) 272-2245. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Dixomara Vargas
Art Unit 2859

3.30.07
BRIJ SHRIVASTAV
PRIMARY EXAMINER